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# Capital Taxation and Globalization

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### Abstract

The decline of capital taxation is associated with efficiency gains. We show that, when agents are heterogeneous, equity concerns can change the policy recommendation driven by efficiency. Given the empirical evidence on the roots of heterogeneity inside each country, either in developing or developed economies, the elimination of capital taxation would lead always to a decline in inequality and to an increase of welfare of the poorest, in a small open economy acting unilaterally. On the contrary for a closed economy, or for group of open economies following the same policy, the opposite can be the result: with the elimination of capital taxation it can hurt the poorest of each country. Therefore a low degree of capital openness can support a positive tax on capital.

**Keywords:** Capital taxation; Incidence; Globalization of Capital Markets; Policy Coordination

Jel codes: D63, E62, F42

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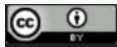
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# **1 Introduction**

In times of low growth and low investment, policies that can improve aggregate investment and aggregate output are especially welcome. Given the high level of public debts in most developed countries, however, the measures under scrutiny should pay for themselves, and should not require alternative financing for the government. This puts a decrease in capital taxation on the table as an alternative to be taken into account. Reduced capital taxation

in the steady state, along with a corresponding increase in labor taxation, increases efficiency: this is a well known result since the work of Chamley (1986) and Judd (1985). Although Carey and Tchilinguirian (2000) estimate that, for the OECD countries, there has been a shift in the relative tax burden from capital to labor, the prescription of not taxing capital is not being taken seriously by policy makers. One reason invoked, among others, is the regressive character of the elimination of the capital income tax, when accompanied by the increase of labor income taxation if the same pattern of government expenditures has to be financed. In short, the policy recommendation of eliminating the tax on capital is a weak one, if it leads to a decline of the welfare of the poorest households in the economy.

This article uses a general equilibrium framework to show that the effect on equity caused by the elimination of the tax on capital could theoretically depend mainly on the joint distribution of characteristics that determine the society's heterogeneity. However, using the empirical evidence on cross-sectional distribution, we show that this result is mainly driven by the degree of effective international mobility of capital. In the case of a small open economy with perfect capital mobility, which decides unilaterally to change policy, we show that inequality is reduced. The intuition for this result is simple: when capital taxation is eliminated, the net return on capital declines in the first period, and net wages in the new steady state are always higher, since the effect of capital inflows on the marginal productivity of labor dominates the higher tax on labor. Since these wages are discounted using the international real interest rate, which is exogenous to policy, the total present value of labor income increases. Therefore, when agents differ in both wealth or labor efficiency, but wealth is more unevenly distributed than earnings, the poorest agents are always better after the elimination of capital taxation.

This result is in clear contradiction with the one in Garcia-Milá, Marcet and Ventura (2010) or Domeij and Heathcote (2004) both of which use a closed economy model. It is also in contradiction with the more popular argument based on a partial equilibrium reasoning: the reduction of the tax on capital and the increase of the tax on labor income increases the return on capital and decreases the return on labor, and therefore benefits the upper income agents and harms the lower income agents. Therefore we try to understand why the degree of capital globalization is a major determinant of how the elimination of capital taxation affects inequality. To understand

the contradiction, we use a closed economy model, similar to the one we had for the open economy, and we repeat the exercise. This allows us to clarify the apparent contradiction between our results and theirs. We show that the difference arises because, in the small open economy, the effect is mainly on investment, while in the closed economy, because savings equals investment in equilibrium, the effect is mainly on impact on the real interest rate and on investment and savings in the long-run. The effect on investment in the small open economy, when not accompanied by an increase in savings, is immediate, while the effect on investment and savings in the closed economy is a slow one over time, leading to a transitional period when instead of capital inflows, the economy suffers a higher real interest rate over time. We show that inequality increases for our calibration, but also that the intuition leads to this being a more general result. Even if as in the general case <sup>1</sup>, efficiency increases for our calibration in the closed economy, using cross sectional data, welfare declines for the two lowest quintiles of the wealth distribution.

The choices of the model and of the method to compare distributions of welfare across different equilibria allow us to separate the effect of the change of policy on efficiency and on equity in a very natural way. We consider an economy with infinitely lived households<sup>2</sup>. The households in our model economy differ in initial wealth and in labor efficiency. Since we assume those distributions to be exogenous, we can replicate exactly the particular moments of the wealth- and earnings-distributions that are crucial to assessing the effects of the tax reform.<sup>3</sup> Households have different levels of efficiency but are not subject to idiosyncratic shocks on these levels. The elimination of idiosyncratic risk means that we are focusing exclusively on

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<sup>1</sup>As claimed in Chari, Christiano and Kehoe (1994) the increase in efficiency of applying the second best solution of capital taxation is mainly driven from the high tax rates in the initial periods. In our exercise capital is taxed at a zero rate after period zero.

<sup>2</sup>Since accounting for the distribution of wealth is fundamental to assessing the consequences of this tax reform, typical overlapping-generation models cannot replicate our results. For an explanation see, e.g., Ana Castañeda, Javier Diaz-Giménez, and Jose-Vitor Rios-Rull, (2003).

<sup>3</sup>In the model, households belong to the same group if they share the same earnings/wealth ratio, and are thus affected in a similar way by the tax reform. Other studies, such as Per Krusell and Jose-Vitor Rios-Rull (1996), use similar partitions of the population. Taxes are used to finance transfers, but transfers are endogenous, and part of a political equilibrium.

the redistributive effects of the policy change, as in Garcia-Milà et al (2010)), and not on its effects on risk sharing, as in Domeij and Heathcote (2004). This last work also computes the optimal tax mix. In this work we do not determine the optimal plan, but rather limit our analysis to the effect on equity of a specific efficient policy measure. Two articles in the literature are specially related to ours. In the open economy literature, Harberger (1995) shows that wages decline due to an increase of the tax of capital in a general equilibrium model of a small open economy, but he assumes that the change in tax revenue is distributed lump-sum and that the tax on labor income is maintained. As described above, Garcia-Milà et al. (2010) studies the elimination of capital taxation in a closed economy. This economy is calibrated for the U.S. aggregate and cross-sectional data, and that the poorest are harmed by the change of policy is its main result.

The exogenous distributions of initial wealth and labor efficiency, as well as the conditions for Gorman aggregation, i.e. that there is a representative agent, considerably simplify the computation of the aggregate general equilibrium effects. These assumptions allow us to perform the exercise without a full characterization of the joint distribution of wealth and earnings. The exercise can be developed using only a subset of the moments of those distributions. To measure the effects of the reform, we compare welfare distributions before and after the reform. The method used is the one developed in Correia (1999) to analyze distributional effects on models with heterogeneous households, and applied in Correia (2010) to study the effect on equity of the introduction of consumption taxation. This allows us to extend the Garcia-Milà et al. (2010) results to closed economies characterized by different cross-sectional data. Moreover it points to and clarifies the crucial role of capital mobility on the effects on inequality of the elimination of capital taxation.

The paper proceeds as follows: In section 2 the household heterogeneity is introduced, as well as the method to compute the effect on inequality of policy changes. The conditions for the evaluation of a positive or negative effect on equity are developed. Section 3 discusses the empirical evidence on the joint distribution of wealth and earnings relevant for the question under study. In sections 4 and 5 we develop the general equilibrium models of the small open economy and of the closed economy, respectively. Given the proposed preferences, for the first one we can give a result generic for any parameterization, while for the closed economy we present a calibration with

standard values for the parameters. Section 5 presents the conclusions.

## 2 Evaluation of Inequality Changes in the Model

Being the main objective of this paper to understand the distributional effects of the elimination of capital taxation we begin by describing in this section the roots of heterogeneity at the time the reform is implemented. After we will discuss how we can compare the cross section distribution of welfare, which depends on these individual characteristics as well as on equilibrium prices, before and after the fiscal reform.

Households are heterogeneous in labor efficiency and in non-human wealth. Each household  $i$  has a deterministic labor efficiency level measured by  $E_i$ , which is constant overtime. This same household holds at every time period,  $t$ , a stock of non-human wealth,  $A_{it}$ , which is decompose in every period in physical capital,  $K_{it}$ , domestic bonds,  $B_{it}$  and, if the economy is not closed, external assets  $B_{it}^*$ , being this decomposition chosen in the previous period,  $t - 1$ . At time 0 this individual non-human wealth,  $A_{i0}$ , is exogenous and its distribution, jointly with the distribution of labor efficiency levels,  $E_i$ , characterize the sources of heterogeneity in this problem. Therefore we assume that agents are identical in every other characteristic.

As described in Correia (1999), comparison of distributions can be very simplified when agents are heterogeneous but Gorman aggregation is still possible. Most used preferences fall under the class that allows for aggregation. Given cross section empirical evidence, we propose the type of preferences used in Greenwood, Hercowitz and Huffman (1988) (GHH), which are characterized by a zero wealth effect on labor decisions. This characteristic implies that households with higher stocks of financial wealth work the same ammount of hours than poor households, when having the same labor efficiency<sup>4</sup>.

Then preferences of household  $i$  can be represented by<sup>5</sup>

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<sup>4</sup>As we will see below financial wealth and labor efficiency are positively correlated for the known empirical studies. This implies that total wealth is positively correlated with hours of work: richer households, with higher wealth also have higher labor efficiency, work more than poor ones.

<sup>5</sup>The qualitative results on equity is maintained with different preference representations. However with isoelastic preferences the increase of wealth has a negative effect on

$$U_i = \sum_{t=0}^{\infty} \beta^t \frac{(C_{it} - \chi N_{it}^{\varphi})^{1-\sigma}}{1-\sigma}, \quad \chi > 0, \varphi > 1 \quad (1)$$

where  $C_{it}$  and  $N_{it}$  represent the consumption and hours of work of agent  $i$  in period  $t$ .

The intertemporal budget constraint of this household can be written as:

$$\sum_{t=0}^{\infty} \frac{C_{it}}{\prod_{s=1}^t (1+r_s)} = \sum_{t=0}^{\infty} \frac{w_t E_i N_{it}}{\prod_{s=1}^t (1+r_s)} + (1+r_0)A_{i0} \quad (2)$$

where  $r_t$  is the net rate of return of non-human wealth in period  $t$ ,  $w_t$  is the net wage rate per unit of efficiency at period  $t$ , and  $A_{i0}$ , the initial non-human wealth, is defined as  $K_{i0} + B_{i0} + B_{i0}^*$ .

It is straightforward to verify that, using the intratemporal first order condition of the household, we obtain the optimal choice of hours, given by:

$$N_{it} = \left( \frac{E_i w_t}{\chi \varphi} \right)^{\frac{1}{\varphi-1}} \quad (3)$$

So it is clear that hours of work do not differ across agents when these have different stocks of  $A_{i0}$  but the same level of efficiency. When richer agents have a higher level of labor efficiency, they will work more than poor agents. Substituting this expression in the utility function (1) and in equation (2) allows us to redefine the optimal choice of consumption over time as:

$$MAX \ U_i = \sum_{t=0}^{\infty} \beta^t \frac{(C_{it} - \bar{C}_{it})^{1-\sigma}}{1-\sigma} \quad (4)$$

subject to:

$$\sum_{t=0}^{\infty} \frac{C_{it} - \bar{C}_{it}}{\prod_{s=1}^t (1+r_s)} = \sum_{t=0}^{\infty} \frac{(E_i w_t)^{\frac{\varphi}{\varphi-1}}}{\prod_{s=1}^t (1+r_s)} \frac{(1 - \frac{1}{\varphi})}{(\chi \varphi)^{\frac{1}{\varphi-1}}} + (1+r_0)A_{i0} \quad (5)$$

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hours, and the higher labor efficiency is not enough to guarantee that rich households work more hours.(see Garcia-Milá et al (2010))



where

$$\overline{C}_{it} = \chi \left[ \frac{E_i w_t}{\chi \varphi} \right]^{\frac{\varphi}{\varphi-1}} \quad (6)$$

Given the isoelastic preferences in transformed consumption,  $\hat{C}_{it} \equiv (C_{it} - \overline{C}_{it})$ , described in (4), the intertemporal first order condition is given by

$$\frac{\hat{C}_{it}}{\hat{C}_{it-1}} = [\beta(1 + r_t)]^{\frac{1}{\sigma}}, t \geq 1$$

This set of equations together with the intertemporal budget constraint, given by equation (5), determine the optimal path of  $\hat{C}_{it}$  for every household  $i$  as a function of prices, the net wages path and the real net interest rate, and endowments, that is, its level of labor efficiency and of initial wealth.

Solving for  $\hat{C}_{it}$  we can write<sup>6</sup>

$$\hat{C}_{it} = G_t [\{r_0^\infty\}] \left[ \sum_{t=0}^{\infty} \frac{(E_i w_t)^{\frac{\varphi}{\varphi-1}} (1 - \frac{1}{\varphi})}{\prod_{s=1}^t (1 + r_s) (\chi \varphi)^{\frac{1}{\varphi-1}}} + (1 + r_0) A_{i0} \right] \quad (7)$$

Note that preferences are homogeneous in  $\hat{C}_{it} \equiv C_{it} - \overline{C}_{it}$ . As well known, due to Gorman aggregation, the indirect utility function can be written as linear in the endowments. Using the definition of  $\hat{C}_i$  in equation (7) in (4), and defining the following monotone transformation of the utility index  $U$ ,

$$u = (1 - \beta)(1 - \sigma) U^{\frac{1}{1-\sigma}}$$

the following expression for each household utility is obtained:

$$u_i^* = H [\{r_0^\infty\}] \left[ \sum_{t=0}^{\infty} \frac{(E_i w_t)^{\frac{\varphi}{\varphi-1}} (1 - \frac{1}{\varphi})}{\prod_{s=1}^t (1 + r_s) (\chi \varphi)^{\frac{1}{\varphi-1}}} + (1 + r_0) A_{i0} \right] \quad (8)$$

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<sup>6</sup>Where  $G_t [\{r_0^\infty\}]$  represents a function of the sequence of net interest rates from  $t = 0$  to  $t = \infty$ .

where  $u_i^*$  is the index of the indirect utility. As said above Gorman aggregation leads to an indirect utility function which is linear in the endowments. As agents are characterized in this problems by two characteristics, we saw that the indirect utility,  $u_i^*$  given in (8), could be written as proportional of a sum of an item linear in  $E_i^{\frac{\varphi}{\varphi-1}}$  and of a second one linear in  $A_{i0}$ .

The utility of the representative agent,  $i = r$ , when wages are standardized so that  $E_r = 1$  and  $A_{i0}$  is the average initial wealth, measures the level of efficiency in this economy. Given Gorman aggregation this level is not contaminated by the distribution of characteristics in the economy neither by its change by the distributional changes imposed by a change of the equilibrium. Therefore in this way we have a very natural way to decompose that total welfare effect of a reform on a efficiency (aggregate) effect and in a distributional effect. We will now describe how we compute this last effect.

To understand the distributional effects of a change in policy, or the effect on equity, welfare distributions should be compared across policies. With this aim we order households by increasing value of transformed consumption, or increasing welfare, measured by  $u_i^*$ . If  $i < j$ , meaning that  $i$  has a lower value of utility than agent  $j$ , we say by short that agent  $i$  is poorer than agent  $j$ . To compare policy 1 with policy 2 in terms of equity we use the concept developed by Marshall and Olkin (1979): the relative differential dominance<sup>7</sup>. This concept is equivalent to an ordering of distributions of utilities (transformed consumptions) across households by the first order stochastic dominance criteria. Note that the ratio of transformed consumption is time independent, that is  $\frac{\hat{C}_{it}}{\hat{C}_{jt}} = \frac{\hat{C}_i}{\hat{C}_j}$ , and therefore is identical to the ratio of the utility indexes ( $u_i^*$ ).

$$\frac{u_i^*}{u_j^*} = \frac{\hat{C}_{it}}{\hat{C}_{jt}} = \frac{\hat{C}_i}{\hat{C}_j}, t \geq 0$$

Let any allocation, or price generally denoted by  $X^p$ , be the equilibrium value of  $X$  associated with policy  $p$ . In our case  $p = 1, 2$ , respectively for policy 1 and policy 2.

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<sup>7</sup>We show in Correia (1999) that this criteria of comparisons includes the Lorenz criteria. It is equivalent to the Lorenz criteria, or to a first-order stochastic dominance criteria, for the population as well as for any sub-group of the population.

*Definition (of relative differential dominance): Policy 2 is equity improving (worsening) in relation to policy 1 iff policy 2 dominates policy 1 in relative differential, that is :*

$$\frac{\hat{C}_i^2}{\hat{C}_j^2} > (<) \frac{\hat{C}_i^1}{\hat{C}_j^1}, \text{ for } i < j$$

If we want to compare the positions of any two agents in the two welfare distributions (one for each policy), we compute what percentage of transformed consumption that agent  $i$ , the poor, should give in case he exchange position on the distribution with agent  $j$ , the richer<sup>8</sup>. We can therefore use the compensation consumption criteria,  $\left(1 - \frac{\hat{C}_i}{\hat{C}_j}\right)$ , that each agent should experience to be as well off in case he moves in the distribution to the location of any other agent. If this compensation decreases,  $\left(\frac{\hat{C}_i}{\hat{C}_j}\right)$  increases, when we change from policy 1 to policy 2, we say that inequality has decreased, because  $\frac{\hat{C}_i}{\hat{C}_j} < 1$ . The choice of the index for individual utility and the choice of relative differential as criteria to compare welfare distributions, free the comparison of welfare across individuals from the usual arbitrariness of cardinality, by reducing it to a consumption compensation criteria.

Cross section data tells us that both wealth and earnings are not equally distributed across households. What happens to condition ?? when both dimensions,  $E_i$  and  $A_{i0}$ , that characterize the household, differ? Let us write  $\sum_{t=0}^{\infty} \frac{(w_t^p)^{\frac{\varphi}{\varphi-1}}}{t} \equiv \alpha^p$  and  $(1 + r_0^p) \equiv \gamma^p$ . In our exercise  $p = 1, 2$ , respectively  $\prod_{s=1}^{p-1} (1 + r_s^p)$

for policy 1 and policy 2. We can state that condition ?? depends both on the general equilibrium effect on prices of the policy change and from the joint distribution of characteristics that characterize the economy. The exact conditions on these two factors are described in the following proposition:

*Proposition 1<sup>9</sup>: Policy 2 dominates policy 1 in relative differential, if:*

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<sup>8</sup>The compensation  $\frac{\hat{C}_i}{\hat{C}_j}$  implies that, after changing to the location of agent  $j$ , agent  $i$  will have  $\left(\frac{\hat{C}_i}{\hat{C}_j}\right) \hat{C}_j = \hat{C}_i$ . Therefore agent  $i$  would give  $\left(1 - \frac{\hat{C}_i}{\hat{C}_j}\right) \hat{C}_j$  to maintain its initial value  $\hat{C}_i$ .

<sup>9</sup>This is Proposition 2 in Correia (2010).

- a)  $\frac{\alpha^2}{\gamma^2} \geq \frac{\alpha^1}{\gamma^1}$   
and  
b)  $\frac{E_i \frac{\varphi}{\varphi-1}}{A_{i0}} \geq \frac{E_j \frac{\varphi}{\varphi-1}}{A_{j0}}$  for all  $i$  and  $j$  such that  $\widehat{C}_i < \widehat{C}_j$ .

**Proof.** We can rewrite relative utilities as:

$$\frac{\widehat{C}_i}{\widehat{C}_j} = \frac{A_{i0} [\alpha/\gamma] \frac{E_i \frac{\varphi}{\varphi-1}}{A_{i0}} + 1}{A_{j0} [\alpha/\gamma] \frac{E_j \frac{\varphi}{\varphi-1}}{A_{j0}} + 1}. \quad (9)$$

To understand the effect of the elimination of capital taxation on equity, we can write the change of  $\frac{\widehat{C}_i}{\widehat{C}_j}$  (in percentage), when policy 1 is replaced by policy 2, as<sup>10</sup>

$$\frac{\widehat{C}_i^2}{\widehat{C}_{j1}^2} \simeq \widehat{\alpha/\gamma_1}^2 \left( \frac{\alpha^1 \gamma^1 A_{i0} A_{j0}}{\widehat{C}_i^1 \widehat{C}_j^2} \right) \left( \frac{E_i \frac{\varphi}{\varphi-1}}{E_j \frac{\varphi}{\varphi-1}} - \frac{A_{i0}}{A_{j0}} \right). \quad (10)$$

Using (??) we can say that policy 2 dominates policy 1 if  $\frac{\widehat{C}_i^2}{\widehat{C}_{j1}^2} > 0$ . Sufficient and necessary conditions for this to happen are:

- a)  $\widehat{\alpha/\gamma_1}^2 > 0$  and b)  $\frac{A_{i0}}{A_{j0}} < \frac{E_i \frac{\varphi}{\varphi-1}}{E_j \frac{\varphi}{\varphi-1}}$ , for  $\widehat{C}_i < \widehat{C}_j$ .<sup>11</sup> ■

*Corollary:* Policy 1 dominates policy 2 in relative differential, *if* from proposition 1 condition a) is not satisfied.

To understand the distributional effects of a policy change just saw that condition a), and c), of proposition 1 depend on the aggregate general equilibrium effect of the policy change on the ration  $\alpha/\gamma$ . This effect depends on the specific environment and, in principle, on the calibration of the model economy. This is the considerations developed in subsection 2.2 and 2.3.

However, on the other hand, condition b), and d), are stated as depending uniquely on the distribution of initial state variables. This allow us to check directly with cross section data whether this is satisfied. Next section will

<sup>10</sup>Where  $\widehat{X}$  is the percentual change of  $X$ , that is  $\widehat{X}_1^2 = \frac{X^2 - X^1}{X^1}$ .

<sup>11</sup>Proposition 1 would also be satisfied when c)  $\widehat{\alpha/\gamma_1}^2 < 0$  and d)  $\frac{A_{i0}}{A_{j0}} > \frac{E_i \frac{\varphi}{\varphi-1}}{E_j \frac{\varphi}{\varphi-1}}$ , for  $\widehat{C}_i < \widehat{C}_j$ . However we will see that this set of conditions is not relevant.

discuss whether there are enough empirical evidence to distinguish between b) and d) of proposition 1, and whether this fact is common to developed and developing countries.

### 3 Empirical facts on the endowments distribution

Our aim in this section is to show that the conditions to satisfy b) from Proposition 1 are quite general. So we will use empirical studies on cross section data or other that had to organize that data in a way that allow us to validate or not that condition b). As we aim to reach a general result we use studies that analyze data of different countries.

From Budria et al. (2002) we use two different set of empirical observations. First, their comparison of the top 1% with the bottom 40% of the distributions for wealth and earnings in the 1980's for the U.S (Table 1 of the appendix). And second, the partition of the sample in wealth quintiles from which we compute the average ratio of  $\frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}}$  for every quintile (Table 2 of the appendix).<sup>12</sup> From Table 1 the ratio between the top 1% and the bottom 40% for wealth and for earnings can be computed. Earnings is the right measure to compute the vector of  $E_i^{\frac{\varphi}{\varphi-1}}$ , because earnings across households in our model are linear in  $E_i^{\frac{\varphi}{\varphi-1}}$ , with a coefficient that is constant across households. Those ratios are respectively 1,335 and 158, so that  $\frac{E_{40}^{\frac{\varphi}{\varphi-1}}}{E_1^{\frac{\varphi}{\varphi-1}}} \geq \frac{A_{40,0}}{A_{1,0}}$ , where 1 and 40 are, respectively, the top 1% and the bottom 40% groups of this two distributions.

The information on the distribution of  $E_i^{\frac{\varphi}{\varphi-1}}$  from the partition of the wealth into quintiles is taken from Table 2 of the appendix. These values are standardized such that the representative agent has  $E_i^{\frac{\varphi}{\varphi-1}} = 1$ . We obtain the vector [.4; .7; .8; 1; 2.1]. An alternative would be to use data presented in Garcia-Milá et al (2010), also for the U.S., and compute the same vector from their wage distribution. In this case we would obtain [.4; .5; .8; 1.5; 3.2]. To obtain the distribution of  $\frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}}$  the two vector were used together with the vector [0; .02; .08; .3; 1.3]<sup>13</sup>. We obtain the following data for the inverse of

<sup>12</sup>See Tables 1 and 2 in Appendix.

<sup>13</sup>Which is standartized data to obtain the average initial capital used in the model

the ratio  $\frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}}$  :

Table 1						
$\frac{A_{i0}}{E_i^{\frac{\varphi}{\varphi-1}}}$	( <i>quintiles</i> )	1st	2nd	3rd	4th	5th
Budria et al	0	.03	.1	.3	.6	
Garcia-Mil et al	0	.04	.1	.2	.4	

Notice that, for both data sets, the ratio  $\frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}}$  is decreasing with wealth.

It is easy to generalize this result to see that  $\frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}}$  declines with the increase in wealth, and the two characteristics are weakly positively correlated.

Both pieces of evidence imply that condition b) of proposition 1 is satisfied.

We can verify that condition b) of proposition 1 is satisfied for a large set of combinations in the space of initial wealth and efficiency levels: If wealth distribution is more unequally distributed than earnings (or wages) and wealth is weakly correlated with earnings<sup>14</sup> then  $\frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}}$  declines with the increase in wealth.

How robust is this evidence to different periods and economies? The described general characteristics of the U.S. distributions of earnings and wealth did not change during the 1990's, and they are common to a large set of European economies, as shown in Budria and Diaz-Gimenez (2007). When trying to infer for developing countries, like Latin America, data is more scarce. Even if inequalities in education, earnings and income have been extensively studied in Latin America, very little is known about the distribution of wealth in this region. However the study of Torche and Spilerman (2008), which focus on the distribution of different assets types across some economic strata, allow us to infer that condition b) of proposition 1 is even more clear in that regions. As claimed in that study: " In all countries for which wealth data is available, the Gini index for household wealth exceeds

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economy, 1.7, and the first quintile was transformed from a negative value to zero wealth.

<sup>14</sup>The correlation can be negative depending on the partition in quintiles being not by wealth but by the ratio of earnings to wealth. In this case our case is even stronger.

the Gini for household income". We can claim that condition b) depends mainly on wealth being more concentrated than earnings and on those two variable being positively correlated, and that these two characteristics of the joint distribution of wealth and earnings are robust across time and space.

Therefore the following result can be stated:

*Result 1: Condition b) of Proposition 1 can be written as  $\frac{A_{i0}}{A_{j0}} < \frac{E_i^{\frac{\varphi}{\varphi-1}}}{E_j^{\frac{\varphi}{\varphi-1}}}$ .*

*Using the same relative differential concept to compare wealth and earnings distributions we can say, for  $\hat{C}_i < \hat{C}_j$ , that this condition is in general satisfied if wealth is more unequally distributed than earnings.*

Having stated that condition b) is a robust one for most developed and developing countries the elimination of capital taxation on inequality will depend exclusively on the effect of the policy change on  $\alpha/\gamma$  (see proposition 1). Below it is compared the effect of the change of policy on  $\alpha/\gamma$ , in the small open economy and in the closed economy.

## 4 The elimination of capital taxation in a small open economy

The model represents an open economy with perfect capital mobility, where the net international real interest rate,  $r^*$ , is exogenous to the country policy. There is only one good produced and imported. Technology is characterized by a neoclassical production function which uses as inputs capital,  $K$ , and labor measured in units of efficiency,  $EN$ ,  $F(K, EN)$ . The government spends a constant exogenous flow of per capita expenditures,  $G$ , and taxes labor and capital income, at the origin, at the tax rates  $\tau_n$  and  $\tau_k$ , respectively. The assumption that the system of taxing capital income is the territorial system implies that the income of external assets held by domestic households,  $B^*$ , is not subject to taxation. The real net return of these assets is the net international real interest rate,  $r^*$ . This constant rate is the one that characterizes the steady state of the rest of the world, which we assume to have fundamentals (technology and preferences) identical to the small economy. Preferences and households endowments are the ones described above in section 2. As said above the vector of  $A_{i0}$  is considered to be exogenous, as well

as its composition. Any change in fundamentals not expected in period  $-1$ , as the change of policy that we want to study, leads to incomplete markets at period 0. This predetermination implies that  $r_0$  (the net return on wealth at the period of the announcement and implementation of the new policy) can be different from  $r^*$ . These assumptions imply that, following the change of policy and with no costs of adjustment of capital, the economy will converge immediately to the new steady state, after one period that differs because the stock of capital in that period was decided previously without the new information. Policy is summarized by a constant stream of government consumption,  $G$ , financed with proportional constant taxes on labor income,  $\tau_n$ , and by proportional taxes on the return of capital net of depreciation,  $\tau_{kt}$ .

The objective of this section is to analyze the effects on the aggregate general equilibrium in this economy of the elimination of capital taxation. For this we compare policy 1, where the economy is characterized by a constant positive tax rate on capital and a constant positive tax on labor, with policy 2, where the economy is characterized by that same capital tax in period zero but with a zero tax rate on capital afterwards and by a constant tax on labor income.

Given Gorman aggregation the general equilibrium of this economy is characterized by equations (3), (6) and (7), with  $r_s = r^*$ , for the representative agent,  $i = r$ , non-Ponzi game conditions for the external debt, and the following equations:<sup>15, 16</sup>

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<sup>15</sup>For simplicity we impose that the initial government debt is zero.

<sup>16</sup>We will represent the partial derivative of function  $F(.)$  in order to the  $i$ th argument as  $F_i$ .



$$Y_t = F(K_{rt}, E_r N_{rt}) = C_{rt} + G + K_{rt+1} - (1 - \delta)K_{rt} + B_{rt+1}^* - (1 + r^*)B_{rt}^*$$

$$K_{r0} \equiv \frac{1}{M} \sum_{i=0}^M K_{i0}; B_{r0}^* = \frac{1}{M} \sum_{i=0}^M B_{i0}^*$$

$$E_r \equiv 1$$

$$\frac{1+r^*}{r^*} G = \tau_n \sum_{t=0}^{\infty} \frac{F_{2t} N_{rt}}{(1+r^*)^t} + \sum_{t=0}^{\infty} \frac{\tau_{kt}(F_{1t}-\delta)K_{rt}}{(1+r^*)^t}$$

$$r_0 = (1 - \tau_{k0})(F_{10} - \delta)$$

$$r^* = (1 - \tau_{kt})(F_{1t} - \delta), \quad t \geq 1$$

$$w_t = (1 - \tau_n)F_{2t}$$

Because we assumed that the international real net interest rate is at the steady state level,  $r^* = \frac{1}{\beta} - 1$ , and  $\hat{C}_{it} = \hat{C}_i$ , i.e., the transformed consumption is constant over time for every household.

As already described the representative agent is the household with the weighted average labor efficiency level of the economy<sup>17</sup> and with the average stock of initial non-human wealth,  $A_{r0}$ . Given preferences and technology, the international real interest rate, as well as the initial average stock of physical capital and of external assets, and given policy instruments ( $G$ ,  $\tau_n$  and  $\tau_{kt}$ ), the aggregate general equilibrium of this small open economy can be computed. This aggregate equilibrium is defined by  $r_0$ , a sequence of prices  $w_t$ , and a sequence of allocations  $\{N_{rt}, C_{rt}, K_{rt+1}, B_{rt+1}^*\}$ .

As described above, the indirect utility of every household can be written as (8), that is exactly identical to the constant value of the transformed consumption  $\hat{C}_i \equiv C_i - \bar{C}_i$ .

$$u_i^* = \hat{C}_i = \frac{r^*}{1 + r^*} \left[ \sum_{t=0}^{\infty} \frac{(w_t E_i)^{\frac{\varphi}{\varphi-1}}}{(1 + r^*)^t} \frac{(1 - \frac{1}{\varphi})}{(\chi \varphi)^{\frac{1}{\varphi-1}}} + (1 + r_0) A_{i0} \right] \quad (11)$$

It is well established in the literature<sup>18</sup> that policy 2 is the best solution to finance  $G$ , when lump-sum taxes are not available and the available taxes are

<sup>17</sup>As said before we choose wage units such that this average efficiency level is one.

<sup>18</sup>See for example Correia (1996).

restricted to be the tax on labor income and capital income<sup>19</sup>. Then, policy 2 is always more efficient than policy 1, i.e. the utility of the representative agent is higher in 2 than in 1.

The effect on efficiency, or the effect on utility of the representative agent,  $i = r$ , can be measured by comparing<sup>20</sup>

$$u_r^* = \hat{C}_r = \frac{r^*}{1 + r^*} \left[ \sum_{t=0}^{\infty} \frac{(w_t)^{\frac{\varphi}{\varphi-1}}}{(1 + r^*)^t} \frac{(1 - \frac{1}{\varphi})}{(\chi\varphi)^{\frac{1}{\varphi-1}}} + (1 + r_0)A_{r0} \right] \quad (12)$$

across policies. The result that efficiency is higher with policy 2 than with policy 1 implies that:

$$\sum_{t=0}^{\infty} \frac{(w_t^2)^{\frac{\varphi}{\varphi-1}}}{(1 + r^*)^t} \frac{(1 - \frac{1}{\varphi})}{(\chi\varphi)^{\frac{1}{\varphi-1}}} + (1 + r_0^2)A_{r0} > \sum_{t=0}^{\infty} \frac{(w_t^1)^{\frac{\varphi}{\varphi-1}}}{(1 + r^*)^t} \frac{(1 - \frac{1}{\varphi})}{(\chi\varphi)^{\frac{1}{\varphi-1}}} + (1 + r_0^1)A_{r0} \quad (13)$$

The neoclassical production function implies that the marginal productivity of capital and the marginal productivity of labor depend uniquely on the capital labor ratio,  $\frac{K_r}{N_r}$ . As the tax on capital income is constant (at different levels) in both experiments for  $t \geq 1$ , the non-arbitrage condition between physical capital and external assets,  $r^* = (1 - \tau_{kt})(F_{1t} - \delta)$ , implies that  $\frac{K_r}{N_r}$  is constant over time, as well as the marginal productivity of labor, for  $t \geq 1$ . The constant labor income tax rate then leads to a constant net wage for  $t \geq 1$  in every case.

Let us assume that technology is Cobb-Douglas, that is

$$Y_t = AK_{rt}^{\alpha} N_{rt}^{1-\alpha}$$

. For  $t = 0$  and using the definition of the marginal productivity of labor,  $F_{20}(\frac{K_{r0}}{N_{r0}}) = A(1 - \alpha) \left( \frac{K_{r0}}{N_{r0}} \right)^{\alpha}$ , and equation (3) we obtain

$$w_0 = A(1 - \tau_n)(1 - \alpha) \left( \frac{K_{r0}}{N_{r0}} \right)^{\alpha}$$

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<sup>19</sup>The period zero tax on capital income, which is a lump-sum tax, is constrained to its value at policy 1, so that lump-sum taxes are identical at policy 1 and 2.

<sup>20</sup>For the small open economy  $G[\{r_{t+1}^{\infty}\}] = \frac{r^*}{1+r^*}$ .

$$N_{r0} = \left(\frac{w_0}{\chi\varphi}\right)^{\frac{1}{\varphi-1}} \quad (14)$$

Eliminating  $w_0$  we can write

$$\chi\varphi N_{r0}^{\varphi-(1-\alpha)} = A(1-\tau_n)(1-\alpha)K_{r0}^\alpha \quad (15)$$

As  $\varphi > 1$ , then  $\varphi - (1 - \alpha) > 0$ , and since  $\tau_n^2 > \tau_n^1$ , then by equation (15)  $N_{r0}^2 < N_{r0}^1$ . As capital in period zero is predetermined  $\frac{K_{r0}}{N_{r0}}$  increases with the higher tax on labor. This increase in the capital labor ratio implies a decrease of the marginal productivity of capital. Therefore gross real interest rate decreases. Since by assumption  $\tau_{k0}^1 = \tau_{k0}^2$ , we obtain:

*Result 2: The elimination of the tax rate on capital income for  $t \geq 1$ , implies that the net real interest rate in period 0 declines, i.e.  $r_0^2 < r_0^1 = r^*$ .*

Using (13) and result 2 we can say that:

*Result 3: The elimination of the tax rate on capital income implies that:*

$$\sum_{t=0}^{\infty} \frac{(w_t^2)^{\frac{\varphi}{\varphi-1}}}{(1+r^*)^t} > \sum_{t=0}^{\infty} \frac{(w_t^1)^{\frac{\varphi}{\varphi-1}}}{(1+r^*)^t} \quad (16)$$

It is now easy to understand the general reason behind the increase of efficiency, or the increase of utility of the representative agent, associated with the elimination of the tax rate on capital income in small open economy: The higher efficiency of policy 2 is not driven by a higher net return on capital, which declines in period zero, but by the increase of the net present value of human capital, even being taxed at a higher rate. The elimination of the tax on capital income leads to a higher capital/labor ratio in the new steady state of the small open economy, that has a positive effect on the net wage stronger than the increase in labor income taxation, except for period zero where the opposite occurs<sup>21</sup>. What condition (16) describes is a stronger

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<sup>21</sup>Using equatios (14) we see that  $w_0^2 < w_0^1$ .

effect: it is a general result that, for  $t \geq 1$ , not only gross wages increase with the elimination of the tax on capital but net wages also increase, more than compensating the decline in the initial net wage. This is the reason why even having a lower net return on initial wealth, there is always an increase of utility of the representative agent,  $t \geq 1$  after the elimination of capital taxation. This is the general equilibrium effects, which goes in opposition to the impact effect, or partial effect: the decline of taxes on capital income after period 1 does not increase the net return on capital after period 1, but on the contrary it declines the net return of capital on period 0. The increase of labor income taxation decline net wages in period zero but increases the net wages for  $t \geq 1$ , in such a way that the sum of present values of wages (or human wealth) increases.

Using the definition of  $\alpha$ <sup>22</sup> and  $\gamma$ , as well as after results 2 and 3, we can now state that:

*Result 4:* In a small open economy in general  $\alpha/\gamma$  declines after the elimination of capital taxation.

Being satisfied proposition 1, because condition a) and b) are respectively results 1 and 4, we can state that:

*Proposition 2:* The elimination of capital taxation in a small open economy decreases inequality in general, both for developed and developing countries.

Given the robustness of result 4, it is easy to say that effect on the welfare distribution would depends crucially on the roots of heterogeneity.

To understand this point let us assume that we had no information on the distribution of cross section characteristics. To determine the effect on equity of the elimination of the tax on capital income let us consider two extreme cases in terms of heterogeneity: In the first one agents have identical labor efficiency levels, i.e.  $E_i = E_r = 1$ , and are differentiated only by different initial levels of non-human wealth. In this hypothetical case condition b) of proposition 1 would be satisfied: the sum of the present value of net wages would increase and the return on initial wealth would decline with the change in policy. Then proposition 1 would be satisfied and inequality would

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<sup>22</sup>In the small open economy  $\alpha \equiv \sum_{t=0}^{\infty} \frac{(w_t)^{\frac{\varphi}{\varphi-1}}}{(1+r^*)^t}$ .

decrease with the elimination of capital taxation. The richer agent is the one that has more initial non-human wealth and the net return on this wealth declined. Besides the item that tries to equalize welfare, the return on human capital, increases its weight due to the increase of the sum of present value of net wages. On the other extreme hypothetical case agents would have identical levels of initial wealth  $A_{i0} = A_{r0}$ . In this case, when agents would differ on labor efficiency, the use of corollary 1 would imply that the move from policy 1 to policy 2 worsens inequality. If the return to initial capital was maintained and the human capital improves that the gains would be higher for those that have higher labor efficiency, that are the richer in this extreme case. In top of this the return on the endowment on which they are identical declines meaning that the share of this item, that is the one that equalize welfare declines. Both reasons lead to a higher welfare of the richer relative to the poor and therefore to higher inequality of welfare across households due to the policy change.

However as stated in result 1 the empirical evidence points strongly to a joint distribution of both characteristics across households, which is biased to the inequality of initial non-human wealth. This explains why we get the result stated in proposition 2.

Using this result for households with welfare smaller than the one of the representative household, that is for  $i < r$ , we can say using directly proposition 2, that  $\frac{\hat{C}_r}{\hat{C}_i}$  decreases. The well established result that efficiency increases with the elimination of capital taxation in a small open economy, is translated as an increase of the utility of the representative agent,  $\hat{C}_r$ . Joining these two results we can conclude that, for  $i < r$ ,  $\hat{C}_i$  increases more than the utility of the representative agent, that is:

*Result 5: In a small open economy the elimination of capital taxation, compensated with an increase of labor taxes, leads to an increase of welfare for every agent with a level of welfare below that of the representative agent*

This is a strong result that claims that the elimination of capital taxation in the small open economy will always lead to an increase of welfare of the "poorest", together with the increase of efficiency.

In the next section we want to check the robustness of the result above to environments where the net interest rate is endogenous to policy. The most natural environment to study this question is when the economy is a closed economy.

## 5 The elimination of capital taxation in a closed economy

The environment of the small open economy described in section 4 is a particular one, in the sense that, after period zero, the real interest rate does not react to the change of policy under study. This assumption would no more be true in the case of a closed economy. The point in this section is to understand why the change from a small open economy to a closed one can revert completely the results, and recover the results in Domeij and Heathcote (2005) or in Garcia-Milá et al (2010). In those works the elimination of capital taxation in a closed economy leads to a decline in welfare of the poorest households of the economy. Their exercise is implemented in an environment which is not Gorman amenable, since preferences are not quasi-homothetic in Garcia-Milá (2010) and markets are incomplete in Domeij and Heathcote (2005)<sup>23</sup>.

The environment now is exactly identical to the one described before, except that there is no capital mobility across countries. Therefore the trade balance cannot be temporary positive or negative: in every time period the supply of goods given by the production of domestic firms has to equalize the sum of private and public consumption and investment. As in the small open economy, in the closed economy the change of policy affects the capital to labor ratio in the new steady state, but in addition it also creates a long period of transition during which wages and interest rates differ from the older and from the new steady state. When capital taxes are eliminated, and compensated by a higher constant labor tax, the economy converges from the steady state path associated with policy 1 to the one associated with policy 2. The equilibrium is characterized by the same set of equations as before, but

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<sup>23</sup>The no-risk case of Domeij and Heathcote (2005) is Gorman agregable but the authors maintain efficiency levels identical across households, and do not emphasize the separation between efficiency and equity that is done in the present exercise.

the households budget constraint is now given by the generic intertemporal budget constraint, equation (5), repeated here

$$\sum_{t=0}^{\infty} \frac{C_{it}}{(1+r_0) \prod_{s=1}^t (1+r_s)} = \sum_{t=0}^{\infty} \frac{w_t E_i N_{it}}{(1+r_0) \prod_{s=1}^t (1+r_s)} + A_{i0} \quad (17)$$

Notice that the only difference from (2) is that the net real interest rate is no more constant nor exogenous. It reacts to the policy change. It will be given by

$$r_t = (1 - \tau_{kt})(F_{1t} - \delta), \quad t \geq 1$$

The resources constraint is now given, for every  $t$ , by

$$Y_t = F(K_t, N_{rt}) = C_{rt} + G + K_{rt+1} - (1 - \delta)K_{rt}$$

Note that the closed economy assumption implies that  $B_{it}^* = 0$ .

We use the standard calibration for annual data. Preferences are such the  $\varphi = 1.8$ ,  $\chi = 2.34$ ,  $\sigma = 1.001$  and  $\beta = .96$ . The technology is Cobb Douglas, the share of capital is .4 and depreciation is .10. The fiscal calibration was such that,  $\tau_k = .5^{24}$  and  $\tau_n = .23$ , which are the average marginal tax rates on capital and the average tax on labor computed in Carey and Tchilinguirian (2000), who update Mendoza et al. (1994) methodology for the period 1980-97. This values are similar to the ones calculated by McGrattan, Rogerson & Wright (1997) for the period 1947-87<sup>25</sup>. Preference parameters and policy are consistent with  $N = .25$  and  $G/Y = .19$ . Government spending is such that intertemporal budget is balanced in this benchmark. Preference parameters lead to an elasticity of labor supply of 1.25<sup>26</sup>.

We compute the steady state of this model, which we denominate benchmark. If there would be no policy changes (policy 1) the economy will be characterized by this solution. Then we solve the model for the same values of parameters and  $G$  but imposing that  $\tau_{k0} = .5$  and  $\tau_{kt} = 0$ , for  $t \geq 1$ <sup>27</sup>, and  $\tau_n$  invariant over time.

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<sup>24</sup>Note that this tax is on capital income net of depreciation.

<sup>25</sup>These authors use an average tax rate on capital of .57.

<sup>26</sup>This value is near the one found in Chang, Kim, Kwon and Rogerson (2011).

<sup>27</sup>As claimed in Chari, Christiano and Kehoe (1994) the increase in efficiency of applying the second best solution of capital taxation is mainly driven from the high tax rates in the initial periods.

The following table summarizes the information necessary for the exercise under study:

Table 1

	$\hat{u}_r (\lambda)$	$\alpha/\gamma$
<i>Benchmark</i> $\tau_k = .5, \tau_n = .23$	5.6 (1)	3.7
<i>Elimination of capital taxation</i> $\tau_k = 0, \tau_n = .35$	5.8 (1.02)	2.9

where  $\hat{u}_r$  is the value of welfare for the representative household at the benchmark, and  $\lambda$  is the change of consumption, relative to the benchmark, in percentage, so that the representative household would be indifferent between the benchmark and the new equilibrium. As described in the section above, the last column give us the ratio of the total return on human wealth to the return on initial non-human wealth, that is  $\alpha/\gamma \equiv \sum_{t=0}^{\infty} \frac{(w_t)^{\frac{\varphi}{\varphi-1}}}{\prod_{s=1}^t (1+r_s)} / (1+r_o)$ .

Given the results obtained in section 3 and using proposition 1, the effect on inequality of the elimination of capital taxation, depends of the effect of policy on  $\alpha/\gamma$ , that whether condition a) of that proposition is satisfied. However, contrary to what happen in the small open economy, in the closed economy the value of  $\alpha/\gamma$  declines with the elimination of capital taxation, meaning that that condition is not satisfied<sup>28</sup>. Then we can state that

*Proposition 3: The elimination of capital taxation in a closed economy increases inequality.*

Therefore it is clear that the opposite distributional effects of the elimination of capital taxation in the open and in the closed economy is due to the opposite effect on  $\alpha/\gamma$  in each one of those environments. The means

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<sup>28</sup>This decline is robust to different preferences, For example the same qualitative effect, the decline of  $\alpha/\gamma$  is obtained with preferences isoelastic in consumption and leisure.



that the path of wages and interest rates after the change of policy should be compared in both environments.

Common to both is the characterization of the new the steady state: the capital to labor ratio increases, due to the elimination of capital taxation, when compared with the one associated with policy 1. Therefore in both environments the net return on capital in the steady state is identical. In the small open economy the net interest rate increases, immediately at period 1, to the new steady state value. However in the closed economy the net interest rate, after period zero, jumps to a value higher than the new steady state, the one associated with policy 1, due to the elimination of taxation. It declines over time, converging during the transition from above to attain the higher steady state associated with policy 2. This is the main effect that helps to give less present value of wages for those that depend more on labor income.<sup>29</sup> This, as well as the path of net wages, contribute to the a lower value of  $\alpha/\gamma$  in the closed economy due to the change of policy<sup>30</sup>, in opposition to the higher one in the small open economy.

We can say that in the open economy the elimination of capital taxation leads to an immediate increase of the capital stock. We can say that it has an immediate investment effect and a slow saving effect since the investment is financed by external savings. This increase will *ceteris paribus* lead to a negative effect on interest rates and to a positive effect on gross wages. In the closed economy savings and investments should be equalized at every period. The increase of demand for investment without having enough savings, since it is costly to decline consumption, leads to an increase of interest rates. Therefore the investment and savings increase slowly to achieve the new capital labor ratio at the new steady state. We can say the equilibrium is achieved immediately in the small economy through increase in quantities and in the closed economy by increase in prices.

In summary, is the change from a positive, in the small open economy, to a negative effect, on the closed economy, on the sum of present value of net wages,  $\alpha$ , the reason behind the opposite effect on inequality in the small

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<sup>29</sup>Gross wages would normally increases over time, being always higher that at the former steady state. But because taxes on labor income increases the path for net wages can be above or below the initial steady state associated with policy 1.

<sup>30</sup>This intuition shows why the result is robust to different preferences, For example the same qualitative effect, the decline of  $\alpha/\gamma$ , is obtained with preferences isoelastic in consumption and leisure.

open and in the closed economy.

The increase on efficiency reported in the first column of Table 1<sup>31</sup>, given that unequally increases, it is not enough to guarantee in general the effect on the welfare of the "poorest". To analyze whether the poor are worse off after the elimination of capital taxation we need more information on the right tail of the joint distribution of earnings and wealth. Equation (8) can be written as:

$$\frac{\hat{u}_r}{\hat{u}_i} = \frac{A_{r0}}{A_{i0}} \frac{[\alpha/\gamma] \frac{1}{A_{r0}} + 1}{[\alpha/\gamma] \frac{E_i^{\frac{\varphi}{\varphi-1}}}{A_{i0}} + 1}. \quad (18)$$

Using the inferred endowments of labor efficiency and initial non-human wealth for the households in the first and second quintile in figure 1, as well as the average initial wealth of the economy  $A_{r0}$ , and substituting in the expression above the values of utility for the representative agent,  $\hat{u}_r$ , as well as the values of  $\alpha/\gamma$  for policy 1 and 2, given in Table 1, the utility index for households in the first and second quintiles,  $\hat{u}_i$ , can be recovered. We confirm that for the cross sectional data of the US and for the calibrated model the welfare of those households decline with the elimination of capital taxation.

The obtained decline of welfare for the poor of the economy confirm the result in Domeij and Heathcote (2004) and in Garcia-Milá et al (2010) that the the elimination of capital income declines total welfare because it declines the welfare of the poorest households in the economy. As said the method used by those authors differ from ours because they use non-agregable preferences and/or no heterogeneity in labor efficiency, when there are no idiosyncratic shocks. At Garcia-Milá et al (2010) the equilibrium prices are dependent on the proposed joint distribution of labor efficiency and initial wealth. Here we show that even if this is not the case in our model the qualitative results are identical. This can be read as being ours a simpler method, and simultaneously a good approximation for the results, or that the distributional effects on the equilibrium aggregates are for this model of second order of importance.

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<sup>31</sup>That the elimination of capital taxation after period zero is efficiency improving in a closed economy is a well established result.(see e.g, Chari, Christiano and Kehoe (1994)).

## 6 Conclusions

We show in this article that the effect on equity of the elimination of the tax rate on capital income depends in a crucial way on the globalization of capital markets. Meaning that whether the elimination of capital taxation leads to a change in the path of the real interest rate or to capital inflows into the country makes the whole difference for the result. In a closed economy the elimination of capital taxation leads to an increase of inequality through the change of the path of capital labor ratio and the effect of this on the net interest rates; in a small open economy the unilateral decision of its government to eliminate the tax on capital implies a capital inflow that leads to a real interest rate always equal (except in period zero) to the limiting one of the closed economy. It is the capital inflow in opposition to the change of the net return that implies the increase of the sum of the present value of net wages in the first case and the opposite in the second one.

The result obtained for the closed economy can occur either because the domestic capital market is segmented from the international market, or because, being capital markets open internationally, the change of policy is taken simultaneously by every other country. Also in this case the adjustment is done through changes in the net international rate of interest and, in the limit when countries are identical, there is no immediate movements of capital across countries but just a change of the interest rate. Capital in each country will increase slowly over time as in the closed economy.

Theoretically the effect on equity would also depend on the roots of heterogeneity across households. However the advantage of our method is to be able to guarantee that the result is well defined: worsens inequality when the country is a closed economy and improves when the policy change is realized in a small open economy. The important characteristic on data is the robust characteristics across economies that wealth is more unevenly distributed across households than earnings.

Besides, as well established in the literature, the effect on efficiency of the elimination of capital taxation is positive, both for the closed and for the small open economy. Both effects, this one on efficiency and the one on inequality, imply that the decision to implement that policy leads to an increase in the welfare of the poorest households in an economy where the change of policy does not alter the real interest rate, that is in the small open economy. On the contrary the segmentation of capital markets in the closed

economy can turn this result round. higher

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## Appendix:

Table1(*Budria et al.*(2002))

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*Table2(Table7inBudriaetal(2002))*

### .Characteristics of Sample Households in Each Wealth Group

Household Characteristics	Households in Wealth Quintiles					Total Sample
	<i>1st</i>	<i>2nd</i>	<i>3rd</i>	<i>4th</i>	<i>5th</i>	
Average Earnings	16.9	27.7	35.1	42.2	90.1	54.8
Average Wealth	−4.1	19.0	72.6	175.3	1,177	288.0